Decellularized rhesus monkey kidney as a three-dimensional scaffold for renal tissue engineering.

Journal: Tissue Eng Part A

Publication Year: 2010

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PubMed link: 20156112

Funding Grants: Preclinical Model for Labeling, Transplant, and In Vivo Imaging of Differentiated Human Embryonic Stem Cells, In Vivo Imaging for the Detection and Quantitation of Transplanted Stem/Progenitor Cells in Nonhuman Primates, UC Davis Stem Cell Training Program, UC Davis Translational Human Embryonic Stem Cell Shared Research Facility

Public Summary:
The goal of this study was the production of a decellularized kidney scaffold with structural, mechanical, and physiological properties necessary for engineering basic renal structures in vitro. Kidney sections were treated with either 1% (v/v) sodium dodecyl sulfate or Triton X-100 followed by quantitative and qualitative analysis. Comparison of decellularization agents and incubation temperatures demonstrated sodium dodecyl sulfate at 4 degrees C to be most effective in preserving the native architecture. Hematoxylin and eosin staining confirmed the removal of cellular material, and immunohistochemistry demonstrated preservation of native expression patterns of extracellular matrix proteins, including heparan sulfate proteoglycan, fibronectin, collagen types I and IV, and laminin. Layering of kidney explants on decellularized scaffolds demonstrated the capacity of the scaffold to support Pax2+/vimentin+ cell attachment and migration to recellularize the scaffold. These findings demonstrate that decellularized kidney sections retain critical structural and functional properties necessary for use as a three-dimensional scaffold and promote cellular repopulation.

Scientific Abstract:
The goal of this study was the production of a decellularized kidney scaffold with structural, mechanical, and physiological properties necessary for engineering basic renal structures in vitro. Fetal, infant, juvenile, and adult rhesus monkey kidney sections were treated with either 1% (v/v) sodium dodecyl sulfate or Triton X-100 followed by quantitative and qualitative analysis. Comparison of decellularization agents and incubation temperatures demonstrated sodium dodecyl sulfate at 4 degrees C to be most effective in preserving the native architecture. Hematoxylin and eosin staining confirmed the removal of cellular material, and immunohistochemistry demonstrated preservation of native expression patterns of extracellular matrix proteins, including heparan sulfate proteoglycan, fibronectin, collagen types I and IV, and laminin. Biomechanical testing revealed a decrease in the compressive modulus of decellularized compared to fresh kidneys. Layering of fetal kidney explants on age-matched decellularized kidney scaffolds demonstrated the capacity of the scaffold to support Pax2+/vimentin+ cell attachment and migration to recellularize the scaffold. These findings demonstrate that decellularized kidney sections retain critical structural and functional properties necessary for use as a three-dimensional scaffold and promote cellular repopulation. Further, this study provides the initial steps in developing new regenerative medicine strategies for renal tissue engineering and repair.